

## TWO NEW CHARACTERS IN THE GEOMETRIDÆ

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The Geometridæ, with over a thousand genera and far more than ten thousand species, have suffered in their classification from a lack of good characters that could be seen without dissection. A large part of the genera are at present based on mere appearance, or features, like the details of the radial venation, which are notoriously variable, so that any other structures that show tangible differences should be taken into account. In an attempt to define better the genera of the eastern United States the two following structures have been noted as relatively easy to see. The first shows good grouping characters, while the second appears erratically, frequently differing between closely related genera, and in a few cases within an obviously sound genus, but is easily seen and rarely shows intermediate states.

### THE CHÆTOSEMA

The Lepidoptera and Trichoptera share a set of curious organs on the top of the head; each a raised area of the surface, bearing a group of radiating setæ, with which in the Lepidoptera ordinary scales may be intermixed. In the Trichoptera there may be several pair of these, and they are merely called the *warts*; in the Lepidoptera there is a single pair, behind the antennæ (or ocelli if present), known as the chætosemas. They vary from massive structures meeting on the mid-line of the head (as in many Zygænidæ) to complete absence, as in the Noctuidæ. In the Geometridæ they are always present, and the typical condition is a smallish round or oval, not too well-defined wart, bearing a group of radiating setæ on each side behind the antenna and separated from it by a bare space, and close above the eye.

This is the condition in all the primitive forms examined, the Brepinæ, most Cœnochrominæ, including the Hedylini and Ametris group; also in all the Hemitheinæ examined, most Sterrhinæ, most Ennomina, and the isolated genera and small groups:

Sphacelodes, the Palyadinæ, the Melanchroiinæ. The only subfamily in which this type has not been seen is the Hydriomeninæ.

The second type is the normal one in the Hydriomeninæ: here each of the two tufts is extended transversely, but gradually narrowing to a point at its upper end. These points may almost meet on the mid-line, but are separated by a wider or narrower bridge of ordinary scaling. This is the normal type in the Hydriomeninæ, where it occurs in all the main sections except the *Eudule* group and a series of genera that appear at first glance transitional to the Sterrhinæ (the Asthenini and Rhodometra types). It also occurs in a number of Sterrhinæ, and here intergrades imperceptibly into the first type, so that it may not be a useful practical character; but curiously in the genera that in other features connect the Sterrhinæ and Hydriomeninæ the structure of the chætosema is clean-cut; the Sterrhines all having the small separate lateral chætosemas, while the Hydriomenines have the Asthenine type, with a procession of setæ across the middorsal line.

A third place where this arrangement of opposed triangles is found is in the *Semiothisa* (*Macaria*) group; and here it looks like a useful grouping character; for it is limited to that group among all the Ennominæ, and intermediate conditions are rare.

So far as our northeastern fauna is concerned the genera which show it are: *Mellilla*, *Isturgia*, *Semiothisa*, *Itame*. *Dysmigia lorica* and *Physostegania pustularia* also show it, but doubtless should be sunk to *Itame*. The transitional types are *Enconista dislocaria* and *Eumacaria latiferrugata*, which should also be separated from *Itame* on clean-cut characters of gena and fore leg (*Enconista*) and venation (both), as well as less striking differences in male genitalia. In these two, while the chætosema is limited to a lateral area and rounded, it is definitely longer transversely than from front to back. A partial survey of outside genera shows it also in the *Semiothisa* group generally, including the primitive African ones with complete venation, *Elpiste*, *Discalma*, and *Tephрина*. Genera with some resemblance to *Semiothisa* and *Itame*, or which have been sometimes grouped with them which have the normal Ennomine chætosema are *Hesperumia*, *Ematurga*, *Orthofidonia*, *Protitame*, *Æthalura*, *Athroolopha*,

*Bupalus*, *Krananda*, *Trigonoptila*, *Zeheba*, and "Macaria" *angustumargo* Warren and *proximaria* Leech. We may note this coincides closely but not exactly with the presence of two strong dorsal spines on the uncus.

The Asthenine type of chætosema is a curious one. There are the two normal lateral tufts, as in most Geometridæ, but between them extends a procession of single setæ in a groove of the scaling right across the middorsal line, the transition from tuft to line being sudden, unlike the forms with transverse triangles. In the true Asthenine group this line is a regular or sinuous curve; as in *Venusia*, *Euchæca* in our fauna and *Asthena* and *Hydrelia* in Europe. *Trichodezia* has an intermediate condition, but probably should also be placed here; and in *Hydrelia* some of the species have the character imperfectly developed, with a well marked interruption of the series of setæ. We also get this line of setæ in a groove of the vestiture in the genera *Pardodes*, *Minoa*, *Hastina* (transitional), *Cambogia* and *Amaurinia*; but in some of these the eyes are so large that the vertex is quite narrow, and then the row may be straight. I have only noted this arrangement among the Sterrhinæ in *Ptychamalia*, but it may be more general in the South American fauna. In our fauna this Asthenine character proves a useful one for *Venusia* and *Euchæca*.

In another small group of genera the chætosema has moved back, so that it is closer to the middorsal line than to the eye. None of these so far as seen are local types; the tuft is small and in this position in two genera examined now standing as CEnochrominæ: *Zanclopteryx* from South America and *Derambila* from the Old-World tropics; while these two genera differ in size of eye and gena, they are closely similar in appearance, and I believe are really closely related. *Derambila* may be of faint interest to North American workers, since it includes the true *lumenaria* Hübner, the species which Hulst unaccountably mixed up with our *pendulinaria*.

In the two African CEnochromine genera *Aletis* and *Cartaletis*, we have still another variation; here the chætosema is far from the eye, but the two almost meet on the middle line, and each is very large and with the bristles mixed with scales, like *Eudule*. It seems hardly likely that there is a real connection with *Eudule*,

but the combination of orange to luteous coloring, day-flight and rubbery "protective" texture is of interest.

*Eudule* itself has a curious chætosema, which reminds one of the Zygænid condition. The organs of the two sides keep of full width or nearly so right to the middle line, where they meet and may fuse indistinguishably. The setæ are mixed (except at the two ends) with whorls of short erect scales; but these are well set off from the ordinary vestiture-scales in front and behind. In the closely related South American genus *Mennis*, the two chætosemas have a short space between them, but still they are broad almost to the middle line, and the admixture of scales is similar.

Finally I have seen a further type in a single undetermined Hydrimenine from Indochina, received as a species of *Pomasia*, but not very close to the descriptions of that genus. In this form each chætosema is a thick crescent, starting on each side at the usual point, but curving around and forward without losing much in width till the two inner ends run parallel to each other between the bases of the antennæ. In this type, unlike the *Eudule* and *Aletis* groups, there are no scales mixed with the setæ.

We may note that the well-known European genus *Odezia*, formerly placed with the Hydrimeninæ but transferred to the Cœnochrominæ by recent workers, has the double triangle normal for the Hydrimeninæ, but entirely unrepresented in the (relatively few) Cœnochrominæ examined.

#### THE GENA

The other neglected character is the gena. This is the strip of chitine which runs across the lower edge of the eye, from the mouth to the occiput. Its development is closely correlated with the size of the eye, but in a few genera it is easier to judge than the latter character. Where the eye is small it is a broad sclerite, while when the eye is large (as usual in the Geometridæ) it is reduced to a narrow strip, or may totally vanish, except for small triangular portions of its front and hind ends. A character more easily used in a key is the presence or absence of scaling on its outer surface; this may vary from nothing or a few scales at the anterior end or a clothing of light and deciduous scales, almost always rubbed off, to a heavy and full clothing, continuous with

that of the front. The genal characters do not tend to make useful grouping characters like the chætosema, but appear erratically—in general broad genæ or scaled genæ are associated with bright coloring and diurnal flight. Usually a whole genus will be alike in these characters, but sometimes they define mere species groups, and they rarely, if ever, hang together for as large a series as a tribe. But except in the few cases where the scaling is limited to the very front edge of the gena, or it is deciduous, they make a very convenient key-character. Roughly speaking, half the genera with broad genæ and small eyes show scaling, but in the genera with narrow genæ and large eyes, scaled genæ are very rare—the only cases noted in our own fauna are *Epirrhoe sociata* (the rest of the genus having small eyes and wide genæ), and male *Cingilia catenaria*, where they are fugitive. There are also a few exotic cases, I think always closely related to small-eyed types.

The following list of forms with scaled genæ show the extremely erratic distribution of the character.

**BREPHINÆ:** *Brephos* and *Leucobrephos*. In both these genera the scaling of the gena is absolutely continuous with the front, but sharply set off from the occiput with a cusp; also the gena has sparse bristles mixed with the scales, a character not noted elsewhere.

**ENOCHROMINÆ:** *Alsophila* (both *pometaria* and *æscularia*) is one of the embarrassing cases. The gena is wide in the female, with well-fixed scaling, very narrow in the male with fugitive scales, hardly ever present in caught material. *Paleacrita*, by the way, shows exactly the same dimorphism, but *Operophtera* is scaleless in both sexes.

Of exotics, *Egea culminaria* shows fugitive scaling, *Zanclopteryx* (but not *Derambila*) has well-set scales; but *Petovia* and *Heliothea*, *Aletis* and *Cartaletis*, show well-developed genæ without scales. Note that *Odezia* has a scaled gena, but this is probably Hydriomenine, as formerly placed (see under the chætosema).

**HEMITHEINÆ:** The only case of scaled gena I have noted is *Mesothea*. In general Hemitheinæ have very large eyes, but even *Chlorissa*, with eyes somewhat reduced, lacks the scaling.

**STERRHINÆ:** Here again large eyes are the rule, but *Xystrota*

and *Holarctias*, with reduced eyes and large genæ, still lack the scaling. I have found them among eastern Americans only in *Timandra amaturaria*, which has a narrow but dense row of scales; curiously, four Old World species of *Timandra* examined had no scales at all, though the gena was not much narrower.

In the yellow South American types formerly called *Cyllopodinae*, the scaled gena is probably a good generic character. They are present in all species of *Cyllopoda* and *Atyriodes* examined, in *Formiana* and *Xanthiris supergressa* and *flaveolata*. They are absent in *Micropos*, also in *Xanthiris superba*, but the latter is abnormal and perhaps should be transferred to *Micropos*.

In the genera which have been more or less debated between the *Hydriomeninae* and *Sterrhinae*, *Rhodostrophia* and *Lythria* have the scaling continued down on the side far below the mouth but then ending abruptly. I think part of this area belongs to the gena. *Rhodometra* (three species) totally lacks the scaling, even though the gena is enormous, and the same is true of *Minoa murinata*, which is sometimes associated with *Lythria*.

**HYDRIOMENINÆ:** In our fauna the scaled gena takes out a clean-cut but heterogeneous list of genera: *Eudule*, *Trichodezia*, *Eulype*, *Epirrhoe*, *Trichochlamys* and *Psychophora*—all small-eyed with the curious exception of *E. sociata*, which still has scales, though it has large eyes and a linear gena. The scales actually make only a single row. *Scordylia* is also scaled, and may include one or more of the species now standing as *Stamnodes*.

I have not cruised the exotics thoroughly, but note that *E. pulchricolora* is a single exception to the scaling of *Eudule*, but *Mennis* has the scales. The *Pomasia* discussed above has a scaled gena. *Erateina* and *Spiloctenia* have a broad densely scaled gena, absolutely continuous with the front but sharply separated from the occiput, suggesting *Brephos* in this one particular. In the *Trichodezia* group I find that the Japanese *T. kindermanni* agrees absolutely with ours (in spite of Warren's remarks in founding *Neodezia*), but *Polythrena*, *Trichobaptia* and *Baptia* have naked genæ.

**ENNOMINÆ:** In this subfamily the distribution of scaled genæ is perhaps even more erratic than in the others, and there are

several cases either of variation within a genus, or perhaps where the scales are as deciduous as the wing scales of *Hemaris*, only appearing on an occasional very fresh specimen.

On either interpretation the character must be used with caution. We have two genera where the scaling is definitely present and well attached in the female, and either absent, or more probably extremely deciduous, in the male: *Paleacrita*, the spring canker-worm; and *Cingilia catenaria*, the Chain-dotted Geometer. In the former case I have seen only a single male with a considerable number of scales, one of *P. merriccata*, though all the decently fresh females show them. In the latter males with some scaling left are not unusual. It is interesting that the species of *Nepytia*, which are otherwise extremely close to *Cingilia*, do not show the scaling in either sex. In the heavily chitinized black-skinned geometers from South America, also, there are enough cases of just a few scales surviving to suggest that better specimens would show them in more species; but I list the genera as the available material shows them.

Scaled genera are *Fernaldella*, with its close European relative *Narraga fasciolaria*; they are well attached in *Isturgia limbaria* (the genotype) but fugitive in *I. carbonaria*, and I have seen no specimens with the scaling preserved of our *I. truncataria*. Present in *Ematurga* and its very close European relative, *Bichroma famula*, also *Bupalus*, but not *Athroolopha* or *Eurrhantis*, while *Dasyfidonia* has a few scales at the front. Present in *Anthometra*, *Pygmaena* and *Psodos*, but not in *Dasydia* and *Acalia*, and generally with a few scales at the front in species of *Gnophos* or none. Of the showy diurnal Old World genera it is present (so far as our specimens are good enough to prove the case) in *Bursada basistriga* Warren and *perdica* Cr., but not several other species of the genus examined, and not in *Milionia* and its close relatives. In the New World it is perhaps fugitive in *Devarodes*, at least I have specimens showing scales in four of six species examined, present in *Melanchroia*, and in the small-eyed species of *Sangalopsis* (where it is probably fugitive again); but it is absent in the large-eyed, blue and red species of *Sangalopsis*, and so far as examined in *Mnesipenthe*, *Drymæa*, and *Sangala*. Evidently it will have to be used with caution in these brilliant tropical rela-

tives of *Cingilia*, but it appears that the size (width) of the gena and the size of the eye are of more value. But the scaling was not found in any of the more normally colored white or translucent species of this complex.

While the preceding account is based on a large number of genera and species examined, including a great many normal for their groups and therefore not listed here; it cannot be considered in any way exhaustive. The size and shape of the gena itself is not considered, and there are no doubt various other genera not available here; and probably a few interesting structures that have simply been overlooked.